

# Occasional Papers On Mollusks

Published by  
THE DEPARTMENT OF MOLLUSKS  
Museum of Comparative Zoölogy, Harvard University  
Cambridge, Massachusetts

MUSEUM OF COMP. ZOOL.  
MAR 10 1946

80304

VOLUME 1

MARCH 15, 1946

NUMBER 7

## The Poison Cone Shell

### INTRODUCTION

By WILLIAM J. CLENCH

The following report on the Poison Cone Shell was published originally in *The American Journal of Tropical Medicine* (Vol. 23, no. 1, January, 1943).<sup>1</sup> Interest in this report far exceeded our supply of reprints and republication seemed necessary.

Three families constitute the sub-order Toxoglossa, the Conidae, Turridae and the Terebridae. So far as known, most species in these families are provided with a poison gland. The radular apparatus is modified and highly specialized as a biting organ and is utilized to introduce the poison into the soft parts of its victim, at least among members of the Conidae. No cases have come to our attention of species in the Turridae or Terebridae inflicting a bite in man. In both the Conidae and Terebridae only the marginal teeth remain and these have become much elongated and spear-pointed. In certain of the Turridae, notably *Drillia*, *Pseudomelatoma*, *Leucosyrinx* and *Ptychosyrinx* the median or rachidian tooth is present. In *Drillia*, it is much reduced, and in addition, possesses lateral teeth which are broad and flat, while the marginal teeth have become elongated. In *Pseudomelatoma*, *Leucosyrinx* and *Ptychosyrinx*, the

<sup>1</sup> Permission to republish this paper has been given by Colonel Charles F. Craig, editor of the *American Journal of Tropical Medicine* and by B.G. Deighton of the Williams and Wilkins Company of Baltimore, Maryland, publishers of this journal. To both of these gentlemen we extend our thanks.

rachidian tooth is large and the marginal tooth elongated.<sup>2</sup> Pelseneer<sup>3</sup> has called the marginal teeth in the *Toxoglossa* "lateral teeth," but we believe in error. When his treatise was written, the radula of *Drillia* was apparently unknown. The broad and flattened lateral teeth and the elongated marginal teeth would indicate that the marginal teeth remained after the loss of either or both lateral and rachidian teeth.

The large species of the Terebridae may very well be as poisonous as the large species of the Conidae, and extreme caution should be exercised in their collecting.

There is a very rich field for the investigator in the tropics. Embryological studies may easily prove the loss, in progression, of the radular teeth. Observations on the poison, its effect and its extent in the very many species that make up these three families is practically untouched as a problem.

Much additional data on the anatomy, especially on the teeth of many species is given by R. Bergh (1895, *Nova Acta der Ksl. Leop.-Carol. Deutschen Akademie der Naturforscher*, **65**, pp. 69-214, pl. 1-13).

A great deal of information is given by M. Phisalix (1922, *Animaux Venimeux et Venins*, Paris, **1**, pp. 470-573) on the poison glands of gastropods. An extensive bibliography is included.

The observation below was kindly supplied by my colleague, Richard W. Foster.

"A year and a half ago I was able to observe the phenomenon of poison ejaculation by one of the common Florida cones.

"Mr. and Mrs. L. A. Burry and I were on our way back to Garden Cove after a two hour collecting trip at Molasses Reef off Key Largo. Our collections for the afternoon were in a couple of shallow white enamel trays. The cones formed the greatest portion of the material. In fact, we had been fortunate in finding twenty specimens of *Conus regius* Gmelin and seventy-five of the smaller *C. citrinus* Gmelin.

"While watching the snails move about and crawl over each

<sup>2</sup> See J. Thiele, 1929, *Handbuch der Systematischen Weichtierkunde*, **1**, pp. 357-375.

<sup>3</sup> P. Pelseneer, 1906, *A Treatise on Zoology*, **5**, pp. 163-166.



Plate 10. Radula: fig. 1. *Ptychosyrinx bisinuata* v. Martens. Fig. 2. *Pseudometatoma moesta* Carpenter. Fig. 3. *Drillia umbilicata* Gray. Fig. 4. *Leucosyrinx crispulata* v. Martens (modified, after Thiele).

other, we teased them with probes in hopes that they would be incited to strike—but to no avail. Suddenly we noticed the fleshy proboscis of a little *citrinus* extend forward and from it we could see the sharp brown needle of a radular tooth emerging. The proboscis was raised in the air and then jabbed forward and downward upon the shell of another *citrinus*. The milky white viscous fluid which spurted from the fang formed a little pool at least one quarter of an inch in diameter. This seemed like a considerable quantity of poison for a snail no more than an inch in length to produce. We wondered what would have happened had our specimen been a large *C. striatus* Linné.”

The report that follows is the same as originally published in The American Journal of Tropical Medicine. The bracketed numbers in the text, i.e., [p. 105], refer to the original pages in that journal. Bracketed numbers on the plates refer to the plate number in Occasional Papers On Mollusks.

### The Poison Cone Shell

By WILLIAM J. CLENCH AND YOSHIO KONDO

[p. 105] During the past one hundred years a few specific cases of death by the bite of a cone shell (*Conus*) have been published. The total list of known cases is not at all impressive and the danger from such a source may be very minor indeed, but it is present and constitutes a hazard that should not be overlooked by the shell collector in the tropics.

In these times when an increasing number of our armed forces are being sent to the tropics, a surprising amount of interest has developed in the collecting of shells in places where they are come upon more or less casually, as while swimming. This report is to focus attention on a potential hazard which might be encountered, especially in the South Seas, and to serve as a warning to those who would hardly expect a formidable danger in the form of a marine snail.

The number of unrecorded deaths from this cause may be fairly extensive as the original “bite” may not have been no-



ticed, particularly if the collector has suffered the usual cuts and scratches that one encounters while reef collecting, especially among live coral.

The primary function of the bite of the cone shell is to paralyze its prey before feeding upon the immobilized victim—a condition strikingly parallel to the use of the poison apparatus in the rattlesnake. A secondary function, though to a lesser degree than in the rattlesnake, is that of protection.

All cones, so far as our experience would show, are exceedingly sluggish and when taken from their environment remain almost completely inactive until they die. However, such cases of death that are recorded indicate that the fatal bite occurred during the collecting and shortly after the animal was taken from the water.

No specific case records are available other than from the Western Pacific, though the species responsible are widely distributed in the Indo-Pacific region. However, it would be wise to consider all cone shells as potentially dangerous. We have made radular slides of several species and all are equipped with a rather formidable biting apparatus, though none so far examined equals in size that of *striatus* figured in this report.

In March, 1941, during the senior author's visit to the Hawaiian Islands, Mr. Clifton Weaver of Honolulu collected a fine large specimen of *Conus striatus* off Rabbit Island, Oahu, in about three fathoms. The junior author dissected the specimen and made the drawings that accompany this paper.

The mechanism of the actual delivery of the poison is still difficult to under- [p. 106] stand. The poison is apparently not delivered directly by means of the poison gland through the individual teeth from their base, but possibly after the wound is made by the tooth and then into the wounded surface, or perhaps through the hollow tooth after it is ruptured from the lingual membrane. It would appear that after the tooth has penetrated the victim a slight retraction would open or rupture the lower barb (figs. 6 and 7) and thus open up the duct for the delivery of the poison. This may then open a channel through which the poison is subsequently ejected by pressure of the muscular proboscis, the entire process being very rapidly carried out.

The following are the several accounts that we have been

able to find regarding known cases of poisoning by various species of *Conus*. We have published these in full as the original records are widely scattered in the various reports and it would be impossible for most people to obtain them unless ready access could be had to large libraries.

Adams, A., 1848, [in] Narrative of the Voyage of the H.M.S. Samarang, **2**, pp. 356-357.

"The animal of *Conus aulicus* has the proboscis beautifully varied with red and white, and there is a square and very minute operculum on the dorsal surface of the hinder part of the foot. Its bite produces a venomous wound, accompanied by acute pain, and making a small, deep, triangular mark, which is succeeded by a watery vesicle. At the little island of Meyo, one of the Moluccas, near Ternate, Sir Edward Belcher was bitten by one of these Cones, which suddenly exerted its proboscis as he took it out of the water with his hand, and he compares the sensation he experienced to that produced by the burning of phosphorus under the skin. The instrument which inflicted the wound, in this instance, I conceive must have been the tongue, which in these mollusks, is long, and armed with two ranges of sharp-pointed teeth."

Gray, J. E., 1853, On the Head of the Genus *Conus* Linn., Ann. Mag. Nat. Hist. (2) **12**, p. 178.

"Its bite produces a venomous wound, accompanied by acute pain, and making a small deep triangular mark, which is succeeded by a watery vesicle. At the little island of Mayo, one of the Moluccas near Ternate, Sir Edward Belcher was bitten by one of the Cones, which suddenly exerted its proboscis as he took it out of the water with his hand, and he compared the pain he experienced to that produced by the burning of phosphorus under the skin. . . . The instrument which inflicted the wound in this instance was probably the tongue, which in these mollusks is long and armed with two ranges of sharp-pointed teeth. (Zool. Voy. Samarang) Mr. Edwards informs me that it adhered to the hand by its mouth like a leech, as described by Adanson."

MacGillivray, J., 1860, Zoological Notes from Aneiteum, New Hebrides, The Zoologist, **18**, pp. 7136-7138.

"On a Poisonous Property attributed to *Conus textile*.—On my first visit to Aneiteum I was told of a shell-fish which, on being incautiously handled, is said to eject a poison, causing, if it comes in contact with the hand, an immediate and peculiar sensation, then numbness of the hand and arm, followed by intense pain, usually severe illness, and not unfrequently death. The native name is Intrag, and the mollusk in question is the well-known *Conus textile*. Having frequently handled this shell-fish while collecting on coral reefs in the Pacific, Torres Strait, and the N.E. Coast of Australia, without having sustained any injury from it, I was naturally somewhat incredulous in the matter; yet as the general belief—which is never wholly destitute of foundation—was against me, I yielded to it so far [p. 107] as afterwards to handle with caution any live specimen I saw. I was told that the small Intrags and those of certain localities (one of which is near my present residence) are reputed more dangerous than others. The Intrag is not usually considered dangerous unless the animal be touched, which of course no one here will do, except unwittingly, but some of the natives say that it can 'blow' the poisonous influence upon the hand of an intruder from the distance of several inches.

"On June 9th of the present year, about 10 P.M. I had brought to me a young man, my neighbor Niuenham, who was said to have recently been poisoned by the Intrag, and appeared to suffer intense pain. From what I could learn it seems that he and a companion had been looking for shell-fish by moonlight about two hours previously. N. had picked up in the shallow water something he did not see distinctly. Immediately on touching it, and while his hand was in the water, he felt a sensation as if some very cold water had been "blown" on the palm of his right hand, and dropped the object, which he saw was an Intrag. Not long afterwards he went home, and soon began to complain of a numbness in the whole of his right arm and hand. This was immediately ascribed to his having touched the Intrag, and his companion went back to the spot for it, carefully picked it up, the shell with the animal retracted, and eventually it was given to me. A bandage was tied tightly

around the sufferer's arm at a little below the shoulder, and when I saw him the arm was cold and much swollen, and the pulse about 50, and very feeble. I administered an enormous dose of the solution of muriate of morphia, as he suffered excruciating pain. A medical man in New Zealand having suggested the experiment of burying the hand and arm affected in fresh earth, this was done, but the patient could not endure it long, for he literally writhed in agony while lying on his face on a mat, with his arm in the ground. Meanwhile a man experienced in such matters had been sent for. On arrival he prepared a knife of two strips of bamboo, and made two deep incisions in the upper part of the arm, one in front, another behind, below the ligature, which had been slackened. About half-a-pint of blood was obtained. Next morning at 8 A.M. I found that the morphia had produced sound sleep during the night, and that the bandage had been removed according to my suggestion. The right arm was swollen, and felt rather cold, but the pulsation was equally strong at each wrist, sixty-three beats to the minute. Means were taken to assist in restoring the natural temperature to the arm, and wine was ordered, to be discontinued on indications of reaction showing themselves. All pain, except from the incisions, had disappeared, and in the course of about a week the patient recovered his usual health. With regard to this case it is right to mention that although satisfied by the circumstantial evidence that contact with an Intrag had produced extraordinary effects, yet I could not separate them satisfactorily from those fairly attributable to the ligature. No pain was felt before the bandage was applied.

"A case which terminated fatally may now be mentioned. On the 28th of May, 1859, I went along with the Rev. J. Geddie to see a sick woman, who, fourteen days before, was believed to have been poisoned by her hands having accidentally come in contact with an Intrag while collecting shell-fish on the reef. The whole right hand and arm to within a few inches of the axilla were in a state of gangrene, with the bone exposed in several places. No haemorrhage, however, had taken place. I could see that numerous small but deep incisions had been made in the arm. There was not, I may mention, as with a light skinned person, the same facility for ascertaining the existence of a line of demarcation between the living and the dead por-

tions of the body. Apparently, there was sound material enough to render amputation at the shoulder-joint possible, but unfortunately, on the back of the shoulder, also on the sides of the chest, there were indications of incipient gangrene in the peeling off of the cuticle, and the formation of vesicles, rendering the operation unadvisable, because holding out no hope of saving life. In this case I learned that a tight bandage had been kept on for several days, probably of itself sufficient to induce mortification even in a healthy limb.

"These two cases are the only ones of which I can say anything from personal observation, and I shall make no further comment than merely to observe that as I cannot find any [p. 108] special apparatus in the animal of *Conus textile*, or see any anatomical difference between it and *C. arenatus* (which is known to be innocuous) after examining both, I feel great reluctance in subscribing even to the universal popular belief on this island of the power of the Intrag to cause injury to man in the manner ascribed to it. A jet from the siphon of the animal might partially account for the first sensation experienced. No puncture or abrasion of the cuticle is ever spoken of, but in some cases, I have been told, the skin has been discoloured,—the word used being "emilmat," which means either blue or green."

Bennett, George, 1860, *Gatherings of a Naturalist in Australasia*, London, footnote, p. 382.

"The common *Conus textilis* of Linnaeus is found at Aneiteum, and other islands of the New Hebrides group; the animal is poisonous. On biting its captor, it injects a poisonous and acrid fluid into the wound, occasioning the part to swell, and often endangering the life of the injured person."

Crosse, H. and E. Marie, 1874, *Jour. de Conchy.* 22, p. 353 (translated by Joseph Bequaert).

[Under *Conus tulipa*]

"According to Dr. Marie, the bite of the animal of *C. tulipa* is as venomous as that of *C. textile*. It is by error, however, that the bite has been blamed on the operculum; it is made by the armature of the tongue."



[Under *Conus textile* Linné]

"This species reaches in New Caledonia a very large size. The fact, mentioned before by several English naturalists, that the bite of *C. textile* is venomous was confirmed in New Caledonia. According to an eye-witness a native of Pouébo, after being bitten on the hand, suffered a considerable swelling of this hand and the corresponding arm with very sharp pain. The swelling persisted for some time. However, the mistake was made in that country of blaming the operculum of the *Conus* for what was caused by the teeth of the tongue."

Montrouzier, R. P., 1877, Jour. de Conchy. **25**, p. 99 (translated by Joseph Bequaert).

"We received from Father Montrouzier, our correspondent in Noumea, a communication which seems to confirm the truth of the venomous properties of the lingual teeth of species of *Conus*, as claimed by some naturalists. Father Montrouzier writes us that at Maré, one of the Loyalty Islands, *Conus marmoratus*, which is abundant there, cannot be handled carelessly without the risk of causing accidents through the bite of its tongue. In the New Hebrides accidents due to the bite of *C. textile* are said to be rather frequent."

Garrett, A., 1878, Annotated Catalogue of the Species of *Conus*, Collected in the South Sea Islands. Quarterly Jour. of Conchology, **1**, p. 365.

In this list of *Conus*, Garrett appends notes on the various species, mainly on their ecology. Under *Conus tulipa* Linn. he has the following note:

"Somewhat plentiful; under clumps of coral on reefs. When collecting at the Puamotus, I found three examples of this species, and held them in my hand while searching for other shells, when one suddenly threw out its long slender proboscis and punctured one of my fingers, causing sharp pain not unlike the sting of a wasp."

Cox, J. C., 1884, Poisonous Effects of the Bite Inflicted by *Conus geographicus*<sup>4</sup> Linn. Proc. Linnean Soc., New South Wales, **9**, pp. 944-946.

<sup>4</sup> *geographus* is the correct spelling.

The following letter was received by Dr. Cox from Mr. B. Hinde R. N. of H.M.S. *Diamond* and published in the above. We copy in full this letter as well as the appended note by Cox.

[p. 109]

"H.M.S. DIAMOND"

"At Sea, Lat. 10° 14' S.. Long. 155° 34' E.

"The following facts which I have learned partly by hearsay, and partly by personal observation, concerning the shell, known as *Conus geographus*, of Linnaeus, may be of interest.

"What first drew my observation to this curious power of *C. geographus* was, a native of Nodup, New Britain, an interpreter on board H.M.S. *Diamond*, seeing me with a specimen of *C. geographus* in my hand, remarked, 'suppose he bite he kill man.' Thinking this to be an exaggeration on the part of the native, but at the same time thinking that he must have some reason for saying so, I enquired of him more particularly as to how the shell would harm any one, as at the time I fancied that he meant if the edge of the shell cut a person by accident it would cause blood poisoning, however, he described how the fish would bite and that the bite was poisonous, and that it always killed people if they did not cut themselves to let the blood run, all round the place bitten, he also promised to procure me a live specimen and shew me how it bit.

"This promise he carried out as nearly as he could for he brought me the shell, but said when he went to take it up the animal had retired or rather, commenced to retire into its shell when he cut off the head, which he brought me separated from the shell. The shell he brought was about 5 inches in length.

"Some time afterwards being in conversation with a Mr. R. Parkinson, a New Britain Cotton Planter, I enquired if he knew any thing about this man's statement about this *Conus*. He told me that he believed it to be perfectly true, and that he had written about it to some one in Sydney.

"I should have taken no more notice of the statement but for the fact, that I saw myself, a native, on the Island of Matupi, Blanche Bay, New Britain, who had been bitten by one, and who had at once cut small incisions with a sharp stone all over his arm and shoulder from which the blood had flowed freely, and he explained to me that if he had not taken these



precautions that he would have died. He explained to me also the shell and how he had been bitten (there was a small mark about the size of a three-penny piece) between his finger and thumb, but upon close examination there were two small incisions in the centre but from which evidently no blood had come.

"I may mention that to stop the bleeding of the numerous cuts in his arm and shoulder, hot wood ashes had been put on them, and the arm seemed to be stiff and useless for the time. But whether this was the effect of the bite or the cure I really am unable to state.

"Many natives whom I questioned, (shewing them the shell at the same time) said that the bite was deadly.

"Hoping that these few observations may be of use either as information, or conformation to Conchologists generally.

"Benj. Hugh Hinde, R.N."

"Dr. Cox stated that an instance had been recorded by Mr. Arthur Adams of a poisoned wound produced by the bite of *Conus aulicus*, Linn. The Rev. W. Wyatt Gill had recorded the fatal effects of the bite of the *Conus textilis*, Linn., and Mr. Brazier had informed Dr. Cox that he had known severe effects caused by the bite of the *Conus tulipa*, Linn. This was the first instance Dr. Cox had heard of the poisonous effects of *Conus geographicus*."

Hedley C., 1892, [in] *British New Guinea*, by J. P. Thomson, London, appendix pp. 283-284.

"The natives are quite aware of the poisonous bite inflicted by several of the Cones. While collecting on a coral reef, I once rolled over a boulder and exposed to view a living *Conus textile*. Before I could pick it up, one of my coloured companions hastily snatched it away, and pointing to its "business-end," explained with vivid gesticulations its hurtful qualities. He would on no account allow me to handle the shell, but insisted on putting it himself into my bottle of spirits."

[p. 110] Coxen, Mrs. C. 1894, *Notes on Poisonous Cones*. Proc. Royal Soc. Queensland, **10**, pp. 38-39.

Mrs. Coxen quotes data from earlier reports which we have republished and adds the following note:

"This account is borne out by a specimen received from Tanna. My late husband sent £2 to a missionary at Tanna for shells. In one of those (a *Conus*) which he received from the missionary is a memorandum—written, I suppose, by the sender—stating that the animal sometimes bites its captor, and injects a fluid poison into the wound which causes death in a few hours through contraction of the throat."

Corney, R. G., 1902, *Nature* **65**, p. 198.

The account given below appears to be about the same person mentioned by Cleland, 1912.

"I notice that doubt is cast on the opinion held by some authorities that the bite of certain species of *Conus* is poisonous; and as a case has now occurred here in a European subject whose intelligence places her account of it beyond question, I think it may be useful to represent the corroborative evidence thus obtained.

"I should mention, first, that a shell exactly similar to the one in question was forwarded to the Australian Museum, Sydney, and that I am indebted to Mr. Etheridge, the curator, for information on the point and for the identification of the specimen as the shell of *Conus geographicus*.

"The patient, Mrs. B., was fishing from a boat after dark in the harbour of Levuka (Fiji), and one of the crew handed her a mollusc he had picked up in shallow water at low tide while getting bait—a *C. geographicus*. Mrs. B., being an old resident in the islands, proceeded to evulse the mollusc with her little finger, the boy having cracked the shell to facilitate this procedure. While doing so she received a puncture, and shortly afterwards felt her hand and fore-arm becoming numb. The effect quickly extended to the shoulder, and the patient had to return to the shore and be conveyed home. In an hour or so she was in great distress, speechless, and paralyzed in most of the voluntary muscles; a condition which later became intensified and alarming, although the cardiac and respiratory muscles showed no evidence of flagging. The medical man who attended Mrs. B. likened her condition to that which might be looked for after poisoning by curare.

"The puncture was so slight as to be scarcely discernible; after two days a steady but slow recovery took place, and a fatal termination was averted.

"During this time the patient did not lose consciousness; but there was for a while some confusion of ideas, and, chiefly, in consequence of the loss of power in the muscles concerned in articulation, she was unable to speak intelligibly, although she subsequently asserted that she knew quite well what was going on around her. She underwent an attack of conjunctivitis a few days later, which she connects with the occurrence; but it is doubtful whether she is right or not in so believing.

Medical Department, Fiji, September 30. 1901."

Cooke, A. H., 1905, Cambridge Natural History, **5**, Molluscs, pp. 65-66.

In this account Cooke states that "The poisonous nature of the bite of certain species of *Conus* is well authenticated," and quotes a few passages from Hinde, MacGillivray, Adams, and Hedley, which are quoted in full elsewhere in the present report.

Cleland, G. B., 1912, Injuries and Diseases of Man in Australia Attributable to Animals (Except Insects). The Australian Medical Gazette, **32**, pp. 269-274; 295-299.

In this report, Cleland has brought together most of the foregoing cases on mollusks (pp. 272-274) and adds considerable new data which we publish here. The report of Dr. Hallen was also republished in the Nautilus, **27**, pp. 117-120, 1914.

[p. 111]

"Phyllum Mollusca.

"Bites of Shellfish of the Genus *Conus*.—Through the kindness of Mr. Charles Hedley, F.L.S., of the Australian Museum, Sydney, who has kindly placed the following references to bites from shells of the genus *Conus* at my disposal, I am able to submit a number of valuable accounts of the severe effects produced in man by careless or inexperienced handling of these animals. Save that one of the implicated species is found along the Great Barrier Reef, the subject is hardly to be considered as strictly Australian, but, in view of the interest attached to the observations, it seemed well to take this opportunity of bringing the references together. I am also much in-

debted to the courtesy of Mr. R. Etheridge, Curator of the Australian Museum, for permission to use the very valuable information supplied by Dr. Corney, the original of which is filed amongst the Museum Records."

"The following report by Dr. A. Herbert Hallen was forwarded to the Australian Museum, Sydney, by Dr. B.G. Corney, from Fiji, 10th September 1901. Accompanying it was a shell, identified as *Conus geographus*, said to be similar to the one that inflicted the severe bite described. The following is the extract from the Government Medical Officer's Report, Levuka, for the month of June, 1901.

"I had under observation the case of a European lady here who was the subject of a severe form of poisoning by a shellfish of the species of which a shell is now sent for identification.

"The lady was fishing not far from the shore in the evening, with her family and native servant in the boat. The shellfish having been obtained, the boy cracked it to extract the meat, which was large in quantity for the size of the shell, and having cracked the shell, handed it to his mistress with the meat hanging from its internal attachment. To free the flesh she inserted her little finger towards the upper end, and, she declares, felt it shoot out a sharp-pointed thing which penetrated her finger and caused such a peculiar sensation that she at once called out that she was bitten and poisoned.

"The poisonous matter is said to be yellow pulpy matter at the thicker end of the shell; it might of course be merely reproductive or digestive tissue, or again there might well be a modification of some secretory gland to form a protective poison gland, and in the latter case, nature would surely provide along with poison, some mechanical means to promote injection into the enemy.

"The point of puncture in this case was minute and only to be seen with great care; indeed, that it was a puncture was much less readily seen than the local effect of the poison which caused a bluish discoloration of the surrounding tissues. It was situated at the point of the patient's little finger near the side of the nail. Through so small a puncture, and in so short a time as was allowed to its insertion (she did not unfortunately suck the wound), but a most minute quantity

of the poison could have entered the circulation, yet the effects were most grave. Locally a numbness was first experienced. This extended rapidly up the arm, which became paralysed and the paralysis spread thence rapidly throughout the body. It was peculiar that not only was general muscular control abolished, even so far that the head had to be supported over the trunk in order that unimpeded breathing might be allowed to continue; but there was a loss also in a lesser degree (as I think) of sensation, with numbness and "pins and needles" beginning in the arm and becoming generalised through the body, and to a more marked degree there was a disappearance of muscular sensation and a complete absence of knee jerks. The patient constantly asked where her limbs were. Utterance was thick and indistinct. The respiratory and cardiac muscular apparatus did not at any time participate to a dangerous degree in the paralysis. The stomach, however, may have been affected, for I could not induce vomiting. When at its worst, some three or four hours after the poisoning began, the condition distinctly affected the throat, and a good deal of distress was caused by the difficulty in removing accumulated fluid. The poison seemed to me to clearly belong to the class of which curare is the type. Of this I felt assured as soon as I had examined the patient and observed the freedom of the respiratory and circulatory centers from its actions compared with the absolute abrogation of voluntary muscular paralysis, so that, the patient weighing 16 odd stone, I felt a good deal of anxiety as to whether the arms would not dislocate at the shoulder when the body was lifted in the chair by the hands under the armpits; indeed it was exceedingly difficult to move the patient, all the parts being so abnormally yielding. The treatment I adopted was merely directed to the maintaining of life till the poison should have been destroyed. The heart and lungs were quite equal to their work if other circumstances could be kept favorable. This was done by placing the patient in a semi-recumbent position in a canvas chair, and by keeping the head in such a position that breathing and swallowing were facilitated. I should have liked to relieve the circulation by inducing vomiting, but failed to do so. Had I had strychnine with me, I should have injected it hypodermically, but I did not feel jus-



tified in leaving the patient to get it. The worst was past in about six hours. The wound was made about 9:30 p.m. Paralysis lasted on with steadily diminishing intensity till late next day, but the numbness lasted considerably longer in the injured finger, and for a month after the patient experienced a shock in the little finger on hard impaction—as in playing the piano. This was the last symptom to clear up, unless the sore eyes, which began and lasted later, are to be attributed to this poison as their cause. Though natives declare that recovery from fish poisoning is often complicated by sore eyes, yet I am not aware that the tradition would apply to this kind. I have heard since of other cases of this kind of fish poisoning, and among others of a Kadavu woman who died before she could be got from the shore.”

Sugitani, F., 1930, On the Poisoning by the Bite of *Conus geographus* Linne. *Venus*, **2**, pp. 151-152.

Written entirely in Japanese. A specific case is given, and then follows a review of this subject, mainly of the case herein given in detail (Cleland, 1912).

Iredale, Tom, 1935, *Nautilus*, **49**, p. 41.

“In June, 1935, a young man examining a cone, apparently *Conus textile*, at Hayman Island, Queensland, was bitten in the hand and died four and a half hours afterwards. This is the first fatal case in Australian history, though a few cases have been recorded from the islands to the north and east.”

Iredale, Tom, 1935, *Jour. of Conch.*, **20**, p. 166.

[Iredale republished his note which was first given in the *Nautilus* (above) about the same case and added the following, listing the various species of *Conus* so far known that have been responsible for such attacks.]

“Apparently he [Charles Garbutt] was handling it when ‘a spike’ came out and pierced his hand. He did not complain of pain until later, when he said his sight was failing and that he had a burning sensation round the mouth. He grew steadily worse and died while being taken to a hospital.

Allan, Joyce, 1935, Poisonous Shellfish. *The Medical Jour. of Australia*, **2**, pp. 554-555, 6 text figures.

"It is reported that a young man has died in Queensland from the effects of the bite or sting of a shellfish. While on a pleasure cruise through the Whitsunday Group of the Great Barrier Reef he was handling a prettily marked shell at Hayman Island<sup>5</sup> when the animal within it pierced his hand. Some time later serious symptoms developed, the patient was hurried to the mainland, by which time he was unconscious, and he died on the way to hospital.

"Though this is the first record in Australia of a death from a bite of a shellfish, or even of an attack of this kind, there are many instances recorded of similar happenings in the South Pacific islands. Scientists have known for many years of the dangerous qualities [p. 113] of certain shellfish and have therefore handled them carefully when removing them from the sea.

"The shellfish responsible for the attacks in the South Pacific have in each case been certain species of cone shells, a large family of brightly coloured shellfish living in warm waters, and particularly common in the South Pacific islands and along the Great Barrier Reef. These shellfish haunt holes and fissures of rock and the maze of coral reefs, where they lead a predatory life, boring into other shellfish and sucking the juices from their bodies. It is almost certain that the species responsible for the recent death in Queensland is one of the cone shellfish. No other types of shellfish have as yet been known to inflict poisonous wounds, though it is suspected that several may be capable of doing so should the occasion arise.

"In numerous scientific publications references have been made to the poisonous qualities of the cone shellfish, and instances quoted where people, mostly natives, have been bitten. These references were given in 1912 by Dr. J. Burton Cleland, at that time stationed at the Government Bureau of Microbiology, Sydney, in a paper published by him in the *Australasian Medical Gazette*, September 14 and September 21, 1912, on 'The Injuries and Diseases of Man in Australia Attributed to Animals.'

<sup>5</sup> This is, apparently, the same case reported by Iredale above.



"This very important paper records all the cases known of poisonous bites of shellfish, from the years 1850 to 1911, and, although at that time there was no record of such an accident having occurred in Australia, as the shellfish responsible were in all cases coned shellfish, and as the different species concerned are also found in Queensland waters, the author rightly considered it advisable to include them in his paper. The recent death has shown that such cases can occur in Australia.

"Shellfish Responsible for Poisoning.

"In all, five different species of cones were responsible for the bites recorded amongst inhabitants of the South Pacific islands. The scientific names of these are *Conus textile*, *Conus tulipa*, *Conus marmoreus*, *Conus geographus* and *Conus aulicus*, all easily recognized species, *Conus textile* and *Conus marmoreus* having the most outstanding colour patterning. If a cone shellfish was responsible for the death in Queensland, it was quite possibly *Conus textile*, because that species occurs so commonly on the Great Barrier Reef, particularly round the islands included in the Whitsunday Group.<sup>6</sup>

"The poisonous bites from cone shellfish known to science occurred in New Guinea, New Hebrides, New Caledonia, Tonga, Samoa, Fiji, New Britain, the Carolines, and the Society, Sandwich and Loyalty Islands. In these places natives were generally the victims, and one is known to have died from the effects. The natives are well aware of the poisonous bites some of the cones can inflict, and have been observed in New Britain cutting small incisions round the place where they have been bitten. It is their belief that unless this is done and the blood is allowed to flow freely, the victim will die.

"In the case at Fiji the victim was a European woman, who was bitten while extracting the animal from a *Conus geographus*, and, although the paralysis which almost immediately resulted from this bite lasted only until the following day, it was quite a month before she felt completely recovered.

<sup>6</sup> Since this article was written the species responsible for the attack has been identified as *Conus geographus*. The actual specimen is now in the Queensland Museum.

### "The Manner of Attack.

"The manner in which a shellfish attacks its victim is rather extraordinary. It is stated earlier that cones are predatory animals which prey on other shellfish and suck juices from their shells. They are able to do this by means of a long, tubular, fleshy structure, known as a proboscis, which can be retracted at will, but when extended reaches beyond the anterior end of the shell. Opening into this tube is a radula-sac containing roughly two [p. 114] rows of numerous teeth and a bundle at the end. When grabbing its food, or when opposed by any outside agency, such as the hand of a human being, the cone immediately shoots out this proboscis and the object is pricked by the sharp points of the teeth, which are hollow and have a swelling at their bases. The poison reaches them from a special poison gland.

### "The Symptoms of Poisoning.

"The symptoms experienced by a person suffering from this shellfish poisoning are, after the first pain of the prick from the sharp pointed teeth, acute pain and considerable swelling, with local numbness which leads to paralysis extending in severe cases throughout the body. The tissue surrounding the minute points of puncture has a bruised appearance, and one or more tiny punctures may be seen. Muscular control goes, and even the head has to be supported in such a way to allow breathing to continue. Speech becomes thick and indistinct, the throat is considerably affected, the eyesight is dim, and a feeling of 'pins and needles' extends throughout the body. Sore eyes appear to be one of the serious symptoms of the poisoning, and in the case of the European woman who was bitten at Fiji, this was the last to disappear. Dr. A. H. Hallen, who described her case in the Government Medical Officer's Report, Levuka, June, 1901, states that natives declare that recovery from shellfish poisoning is often complicated by sore eyes. Possibly the state of health of the victim at the time of an attack would either help or hinder his recovery. The Queensland victim complained of failing eyesight an hour or so after he was bitten. He became drowsy, as in snake-bite

poisoning, and later fell into a coma, from which he did not recover.

"There has, to my knowledge, been no literature published on the proper treatment for this poison. As a case, with unfortunately fatal results, is reported to have occurred in Australia, there is ample opportunity for a medical man, interested in this branch of his science, to investigate the poison of cone shellfish and its treatment."

Flecker, H., 1936, Cone Shell Mollusc Poisoning, with Report of a Fatal Case. The Medical Jour. of Australia, **1**, pp. 464-466, 2 text figures.

In the above citation, Flecker has reviewed most of the cases that we have published in detail. We add only the new information. The case of "C. H. G." refers again to the paper by Iredale (herein quoted) but it gives much additional information of interest to the medical student. We have not seen the report by Cleland in the 6th Report of the Microbiological Laboratory of New South Wales, so we quote this from Flecker's report.

"Professor Cleland quotes the following extract from 'Life in the Southern Isles,' by the Reverend W. Wyatt Gill. On the island of Mare (southernmost of the Loyalty Group, immediately to the east of New Caledonia), in the doubtful light, a native 'unhappily took a good-sized shellfish (*Conus textile*) and put it in his basket. He immediately felt a painful sensation running up his right arm to the shoulder. He went home. The pain increased until he writhed in agony. The body swelled to an enormous size, and by daylight he was a corpse.'

"Of the above cases there were two caused by *Conus aulicus* and *Conus tulipa* respectively, and these appear to be relatively mild; two instances of poisoning by *Conus textile*, one mild and the other fatal; and two of *Conus geographus*, one perhaps mitigated by treatment by incision and the other severe.

"Early this year it was decided, at a conference held at Cairns, to form a Registry of Injuries Caused by Plants and Animals in Tropical Queensland, and accordingly questionnaires were forwarded to all the medical practitioners practising in North Queensland. The first case reported was by Dr.

T. B. Clouston, then at Proserpine, to whom I am indebted for details of the fatal case here recorded.

"C. H. G., a male, aged twenty-seven years, whilst on a pleasure cruise landed at Haymen Island on June 27, 1935, and picked up a live cone shell (since identified by Mr. H. A. Longman, of the Queensland Museum, as *Conus geographus*). According to an eye-witness, it was gripped in the palm of one hand, with the open side downwards in contact with the skin, whilst with the other he proceeded to scrape with a knife, the epidermis, that is, a [p. 115] thin cuticle covering the hard part of the shell. It was during this operation that he was stung in the palm of the hand. 'Just a small puncture mark' was visible. Dr. Clouston did not see the patient until just before death, but the following details were obtained by him from the patient's mother, who was present with him. Local symptoms of slight numbness started almost at once. There was no pain at any time. Ten minutes afterwards there was a feeling of stiffness about the lips. At twenty minutes the sight became blurred, with diplopia; at thirty minutes the legs were paralysed; and at sixty minutes unconsciousness appeared and deepened into coma.

"No effect was noted upon the skin, lymphatic, alimentary or genito-urinary systems. Just before death, the pulse became weak and rapid, with slow, shallow respirations. Death took place five hours after the patient was stung.

"A post mortem examination showed that all the organs, heart, lungs, et cetera, were quite healthy. Mr. J. B. Henderson, Government Analyst, reports that no poison was found in the stomach contents. The victim was prior to the injury in perfect physical condition and in training for football.'

"The symptoms resemble much those of curare poisoning as described in earlier reports. As usual, the puncture was in the hand and insignificant in size. The most striking difference was the entire absence of pain, although there was a feeling of stiffness. This is in contrast to Case I [A. Adams], in which the pain (*Conus aulicus*) was compared with the burning of phosphorus beneath the skin; Case II [Crosse and Marie] (*Conus textile*), in which severe pain persisted for some time; Case III [A. Garrett] (*Conus tulipa*), in which there was sharp pain, not unlike the sting of a wasp; and Case V [G. B. Cleland]

(also *Conus geographicus*), in which the patient felt a sharp-pointed thing, which made her call out at once that she was bitten and poisoned. The victim of the fatal stinging by *Conus textile* immediately felt a painful sensation running up to the shoulder, which increased until he writhed in agony."

Yasiro, H., 1939, Fatal Bite of *Conus geographicus*, *Venus*, **9**, p. 165-166. [The Translation (below) of this paper appears anonymously in the *Proc. Mal. Soc. London*, 1940, **24**, p. 32].

"On 29 June 1935 a man 32 years old left home about 10 a.m. for bathing and shell-collecting. Soon after he was infected by the bite of a *Conus geographicus*. He immediately felt great pain and scarcely managed to walk home. A doctor attended promptly; the patient's temperature arose to about 36°C. (= 113°F), breathing became difficult and his fingertips went purple. He was soon unconscious and died about three to four hours after infection. The shell is stated to be about 13.5 mm. long; perhaps this is a misprint for 13.5 cm."

The following citation is added as such published observations are exceedingly rare. It indicates the protection the bite affords against an enemy that is quite numerous in ecological areas where members of *Conus* are also present.

Cummings, Bruce, 1936, *North Queensland Naturalist*, **4**, Cairns, p. 42: Encounter Between Cone Shell and Octopus.

"In the course of seeking material for cinematographic study, a small party set out on the exposed reef at Green Island and came across a small octopus whose tentacles extended some eight or nine inches from its body. Placing this in an enamel pail of sea water, a further search resulted in the discovery of a live cone shell, *Conus textile*, which was likewise deposited in the same receptacle, where the cephalopod was swimming about freely.

"It was not long, however, before the latter was aware of the presence of the cone, and some twenty minutes or so later, as is usually the case in attacking gastropods, placed one of its tentacles across the entire length of the narrow opening of the shell, the tip of the tentacle entering further than the remainder. (The mouth of the shell measures two and a quarter inches



long by about five-sixteenths of an inch wide.) About twenty seconds later the octopus quickly withdrew its hold waving its tentacles about with a writhing motion as though violently agitated.

[p. 116] "Inspection of the shell immediately after the withdrawal of the tentacles revealed a thin round spike-like object, evidently the radula being withdrawn. This spike-like radula was about an inch in length tapering from its proximal extremity to a point distally, and was bright red in color. A few minutes later it was noted that the octopus had shed one of its tentacles, it being detached close to its body.

"The octopus was transferred to a glass tank and although well supplied with abundant fresh sea water it was found dead on the following morning. On the other hand the cone shell did not suffer any apparent injury and is still alive and in excellent condition ten days later.

"When the radula is protruded, it is seen directly beneath the syphon, the latter having a red band at its free extremity, a white ring around its centre and a black band proximally. The cone itself measures two and a half inches in length and an inch and three-sixteenths in diameter.

"In view of the reported case of a fatal issue following the bite of a native of New Caledonia in 1847 from this shell as well as of similar fatalities from other species of *Conus*, this encounter between the two molluscs is interesting. No doubt, such are of frequent occurrence although rarely observed."

#### ANATOMY OF CONUS STRIATUS LINNÉ

The alimentary canal anterior to the mantle consists of the oral aperture, vestibule, buccal canal, pharynx, radula sheath, salivary gland, poison gland, and the oesophagus (crop).

Figure 1 shows the gross external anatomy of the *Conus*, the softer parts having broken off during extraction. Figure 2 shows the same with the vestibule and external covering laid back to reveal the organs *in situ*. The proboscis, figure 3, consists of a thick, wrinkled outer covering underlaid by a layer of longitudinal muscles. Below this layer are numerous retractor muscles. The buccal canal lies therein and consists of a tough conical anterior portion and a thin but large posterior part separated by a circular muscle bundle. The conical

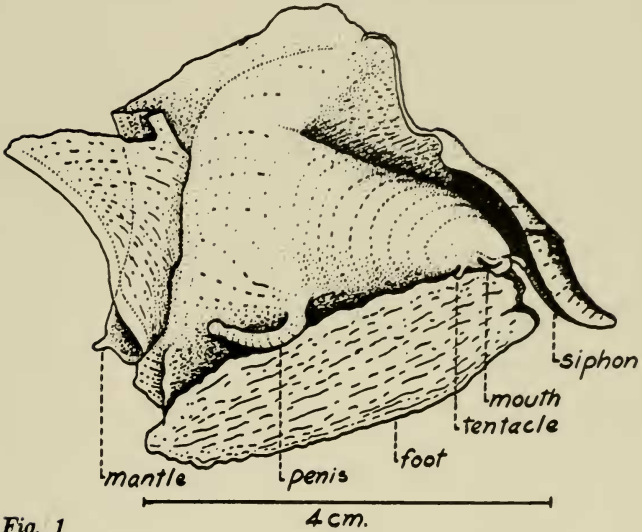


Fig. 1

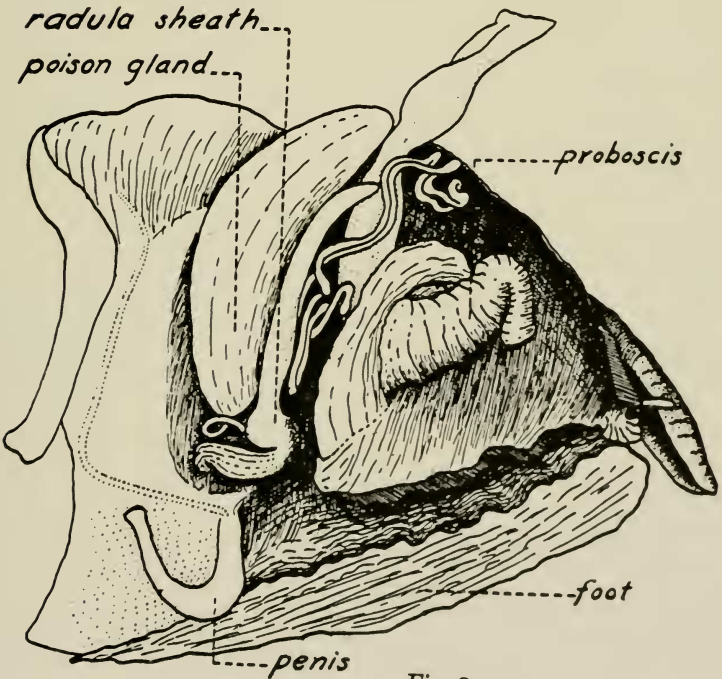


Fig. 2

[Plate 11]

Fig. 1. Anatomy of *Conus striatus* Linné

Fig. 2. Fore digestive part in position of *Conus striatus*



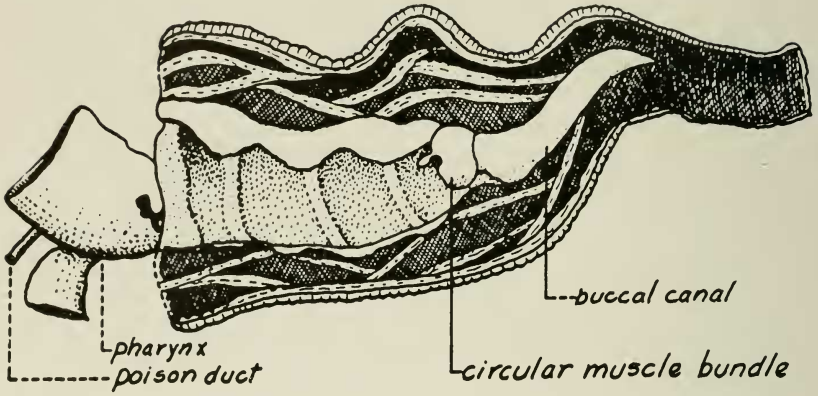


Fig. 3

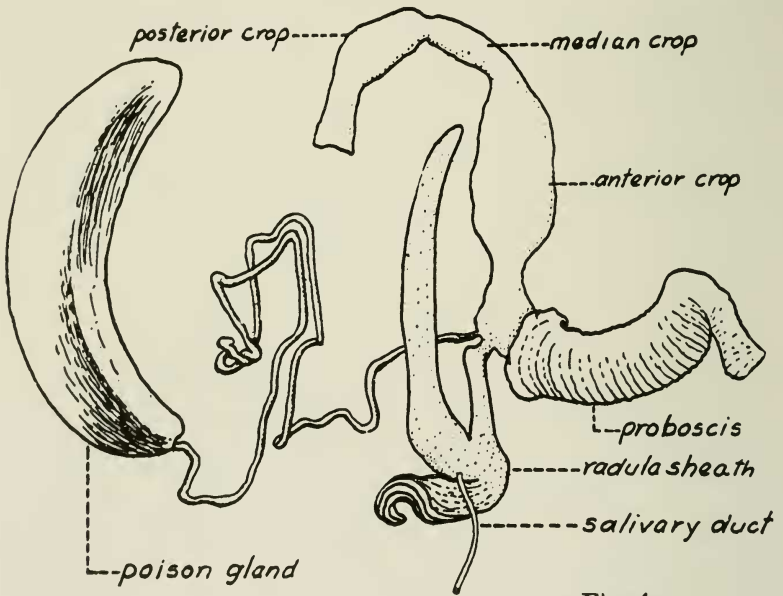


Fig. 4

[Plate 12]

Fig. 3. Internal anatomy of proboscis of *Conus striatus*Fig. 4. Fore digestive system of *Conus striatus*

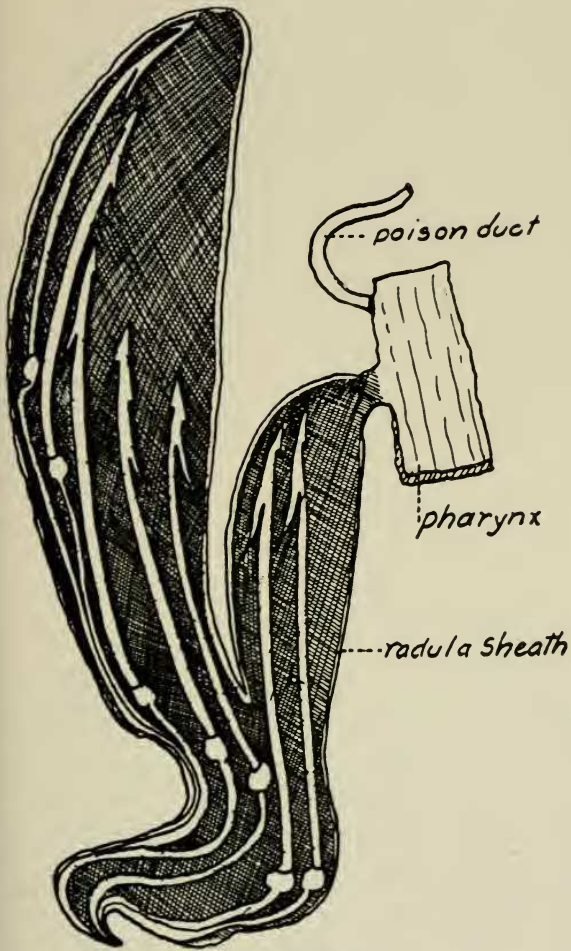


Fig. 5

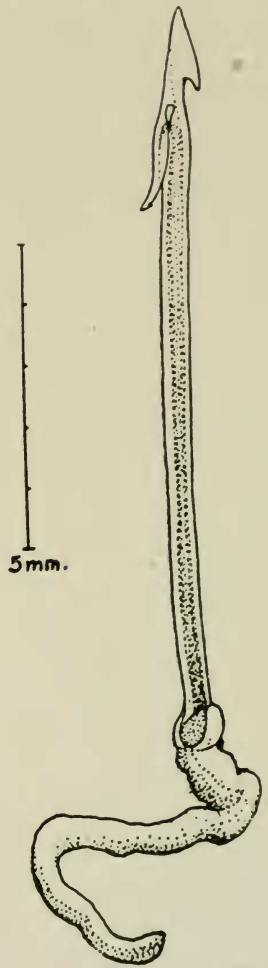


Fig. 6

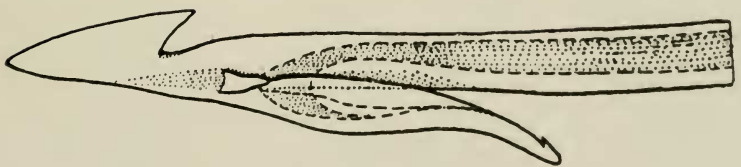
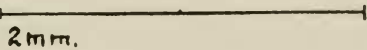


Fig. 7



[Plate 13]

Fig. 5. Radular sheath opened of *Conus striatus* (free hand). Fig. 6. Greatly enlarged radular tooth of *Conus striatus*. Fig. 7. Greatly enlarged tooth of *Conus striatus* showing barb.

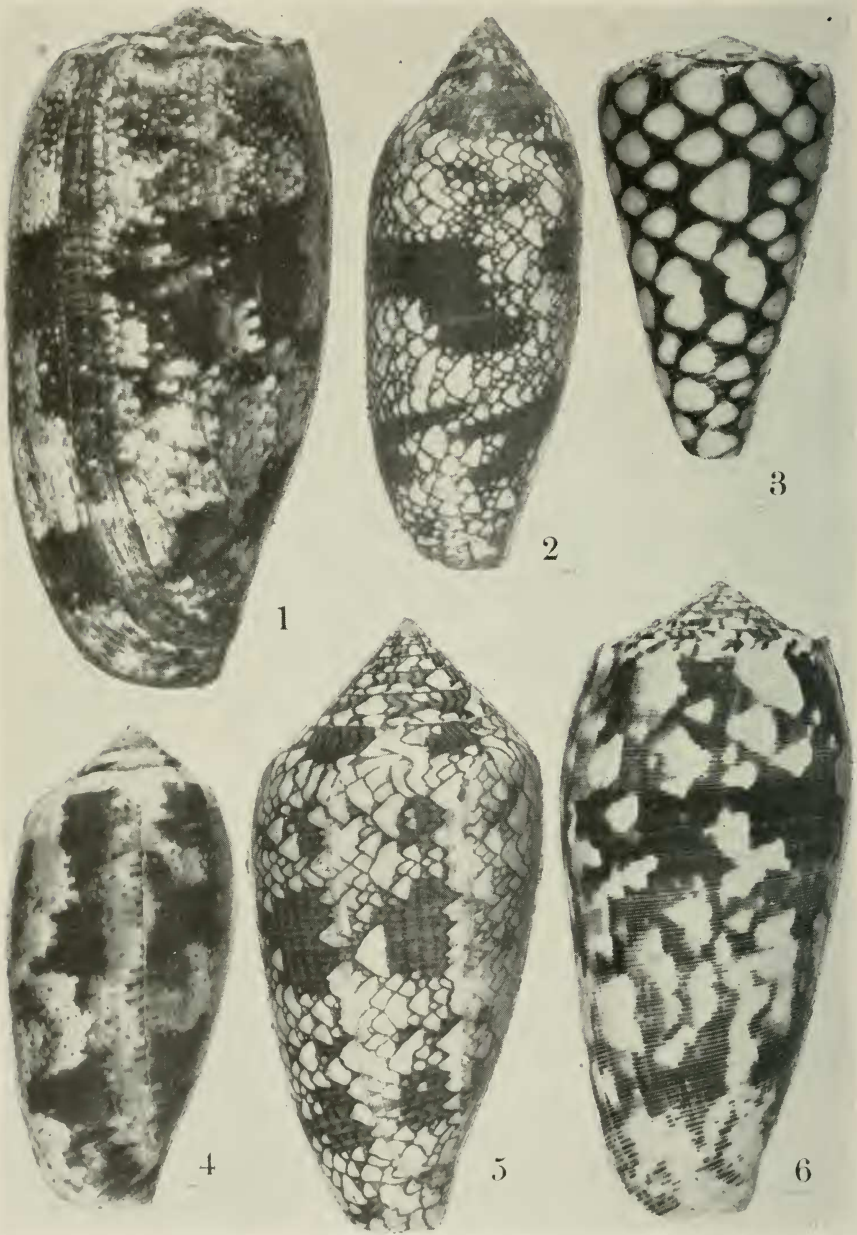


Plate 1 [Plate 14]

Fig. 1. *Conus geographus* Linné. Fig. 2. *Conus aulicus* Linné. Fig. 3. *Conus marmoreus* Linné. Fig. 4. *Conus tulipa* Linné. Fig. 5. *Conus textilis* Linné. Fig. 6. *Conus striatus* Linné.

portion engaged the sharp spear-like tooth and probably is also a thrusting organ as it is quite tough and filled with numerous bundles of longitudinal muscles. In the crop of our specimen there was found the remains of a fish together with a radula tooth.

Figure 4 shows the relationship between the alimentary organs of our specimen. Simroth's *Giftdrüse*, or poison gland, is quite large. Its vessel, which is 13 cm. long, opens into the pharynx 2 mm. posterior to the opening of the radular sheath. It is not certain how the poison is syringed into the hollow teeth.

Figure 5 is a sketch of the opened radular sheath showing the arrangement of the teeth. The actual number dissected out was about 40.

Figures 6 and 7 which are greatly enlarged, exhibit two drawings of the tooth of *C. striatus*. The crystalline portion is 12-13 mm. long, sharply pointed at the apex and bulbous at its base. To the base is attached a transparent cartilaginous appendage. The apex of the tooth is armed with three barbs; the apical, the single small median and the curved posterior.

The pharynx opens anteriorly into the buccal canal by a narrow aperture, figure 3. Posteriorly it soon bulges out into two crops which for this paper may be called the anterior and posterior crops. A short narrow tube connects the two. In the anterior crop were found the skeletal remains of some small fish. [p. 120] They appear to be portions of the skull, fin, and a segment of the vertebra. There were also bundles of crystalline spicules which could not be identified. In the median crop or the narrow connecting tube was a well preserved tooth of the *Conus* itself, which is without doubt the one used to kill the now partially-digested prey. In the posterior crop were found two valve-like objects, perhaps made of horny material, which may either be a bivalve eaten prior to the fish, or a grinding mechanism. What leads us to suspect the object to be a pulverizing mechanism is that it was deeply embedded in the wall of the crop (though not attached by muscles) and that between the valves was a bundle of crystalline spicules similar to the kind found in the anterior crop.

[end of reprinted paper]

## DESCRIPTIONS

We add the following brief descriptions of the five species of *Conus* whose bite is known to be serious. *C. striatus* Linné has not been recorded injurious to man.

All of these shells possess a thin brownish periostracum when collected alive, though upon drying, this usually scales off. Our plate is based upon shells without the periostracum.

These species of *Conus* are wide ranging in the Indo-Pacific region. They are all tropical and do not extend into the temperate portions of this area. They probably occur wherever coral is to be found. All frequent coral reefs, generally behind the reefs and under slabs or blocks of dead coral. They are nocturnal in habit and, with the aid of a flash light, can be found crawling around in exposed places.

***Conus geographus* Linné**

Plate 14, fig. 1

Shell 3 to 5 inches in length, rather wide, fairly thin in structure. Color consisting of irregular patches of mahogany brown with two more or less distinct spiral bands of the same color over a cream or bluish white ground. Spire depressed and with a series of small knobs on the shoulder of the whorl. Sculpture consisting of fine growth lines.

***Conus aulicus* Linné**

Plate 14, fig. 2

Shell 3 to 5 inches in length, slender, rather thin in structure. Color consisting of numerous white tent-shaped figures on a dark mahogany background. Spire extended terminating in an acute apex. Sculpture consisting of fine growth lines and very fine spiral threads.



**Conus marmoreus** *Linné*

Plate 14, fig. 3

Shell 2 to  $4\frac{1}{2}$  inches in length, cone shaped, rather heavy in structure. Color consisting of white and irregular tent-shaped figures on a chocolate background. Spire depressed and generally with a series of small knobs on the shoulder of the whorl. Sculpture consisting of fine growth lines and very fine spiral threads, somewhat stronger on the lower third of the shell.

**Conus tulipa** *Linné*

Plate 14, fig. 4

Shell 2 to 3 inches in length, fairly wide, rather thin in structure. Consisting of irregular patches of mahogany brown with two bands of the same color over a bluish white ground. In addition there are numerous and fine lengthened dots arranged in rather close-set spiral lines. Spire depressed, generally smooth over the whorl shoulder. Sculpture consisting of very fine growth lines.

**Conus textilis** *Linné*

Plate 14, fig. 5

Shell 2 to 4 inches in length, somewhat slender, rather heavy in structure. Color consisting of numerous small, white, tent-like figures over a yellowish brown ground color. Spire extended, terminating in an acute apex. Sculpture consisting of very fine growth lines.

**Conus striatus** *Linné*

Plate 14, fig. 6

Shell 3 to  $4\frac{3}{4}$  inches in length, rather slender and heavy in structure. Color consisting of irregular patches of dark chocolate brown, more regular in the center and at the base to form two rather indistinct bands. This color is on a ground of a pale brownish cream. Spire depressed and having a rather sharp ridge at the whorl shoulder. This feature produces a groove between each of two whorls on the spire. Sculpture consisting of fine growth lines and, in addition, very numerous and fine spiral threads more or less evenly disposed over the entire surface of the shell.

\* \* \* \*

J. R. le B. Tomlin has published the following catalogue in which he gives references to all species in this genus, both recent and fossil, that have been described as late as 1936.

Catalogue of Recent and Fossil Cones. 1937, Proceedings of the Malacological Society of London, **22**, pp. 205-330; *ibid.* p. 333.